Fermilab

Particle Physics Division

Mechanical Department Engineering Note

Number: MD-ENG-193 Date: 7/10/2009

Project: PHENIX

Project Internal Reference:

Title: 90° Peel Strength Test on ARCLAD 8026 Tape

Author(s): C. M. Lei

Reviewer(s): David Rossi 7/14/09

Key Words:

Abstract/Summary:

Arclad 8026 silicone tape is being planned to use in the PHENIX pixel detector being upgraded at Brookhaven National Laboratory. It will be used for gluing the silicon module to the kapton HDI cable and to the graphite substrate as well. Compliant silicone adhesive is chosen, not only because it is radiation hard and transparent to the particles, but also because it can effectively minimize the thermal stresses caused by the mismatch of the coefficient of thermal expansion (cte). However, it was thought that the strengths of silicone adhesive were quite low and a test on the mechanical strength was desired to be conducted because the vendor could not provide this data. A 90° peel strength test using some simple apparatus was thus chosen, and silicon and kapton as the adherents were used. This result was then compared to another popular acrylic tape 3M 9882 which is a much stiffer adhesive.

Applicable Codes: ASTM D3330

90° Peel Strength Test on ARclad 8026 Tape

C. M. Lei
Bert Gonzalez

FermiLab

3/27/2009

Introduction:

Arclad 8026 silicone tape is being planned to use in the PHENIX pixel detector being upgraded at Brookhaven National Laboratory. It will be used for gluing the silicon module to the kapton HDI cable and to the graphite substrate as well. Compliant silicone adhesive is chosen, not only because it is radiation hard and transparent to the particles, but also because it can effectively minimize the thermal stresses caused by the mismatch of the coefficient of thermal expansion (cte). However, it was thought that the strengths of silicone adhesive were quite low and a test on the mechanical strength was desired to be conducted because the vendor could not provide this data. A 90° peel strength test using some simple apparatus was thus chosen, and silicon and kapton as the adherents were used. This result was then compared to another popular acrylic tape 3M 9882 which is a much stiffer adhesive.

Samples Preparation:

Arclad 8026 silicone tape just has a shell life about one year. Fresh adhesive tape in one-mil thick was obtained and used to glue between a piece of flexible kapton and silicon. The test samples were 15/16" wide, and about 3" long adhesion area was covered. During the curing process, 3 kg weight was applied on the adhesion area evenly at room temperature. Test was then done after samples had been cured for more than 2 weeks.

Apparatus:

According to the ASTM D3330 testing standard, a constant-rate-of-extension tension tester like Instron should be used. However, since the Instron testing machine at Fermilab was quite occupied and a couple of special fixtures were needed to be made for the Instron, this machine was not adopted and another simple vertical rail with a hand-rotating crank was used. This device was originally a dial gauge with a crank base, an electronic force gauge was then attached to the hand. The force gauge was equipped with a hook at top so that a pulling force applied to the sample was made possible. As shown in Figure 1, the test sample was held firmly by vacuum on a flat granite table and an overhand bout 3 mm was allowed so that the flexible kapton could be pulled down vertically and got peeled for this amount. Also, a simple paper clamp was modified to provide the pulling spot. The set up was then ready for the peeling test.

Test:

Caution was needed to clamp the modified paper clamp on the kapton properly so that the pulling force being applied was right at the width center. Otherwise, the peeling was initiated from a corner and the peeling strength across the whole width might not be obtained. Also, the contact pulling point at hook up was visualized to ensure that it was right below the overhang of the sample so that it was really a 90° Peel Strength Test. According to the ASTM D3330 testing standard, a uniform pulling rate of 5 mm per second is suggested. It was thus experienced how to achieve it with the crank before the test first and then executed it similarly when the real tests were conducted. Gauge was reset to zero every time before the peeling force was applied. Reading was then taken and repeated for all samples.

Figure 1 90° Peel Strength Test Set Up

Results:

Sample width in inches =		0.9375
Sample #	Max Force registered in lbs	Peel Strength, lbs/inch
1	2.8	2.99
2	3.5	3.73
3	3.76	4.01
4	3.18	3.39
5	3.76	4.01
6	2.98	3.18
Average	3.33	3.55

The accuracy of this test was estimated to be about +/- 10%.

Comparison with another adhesive:

2-mil-thick 3M9882 acrylic tape was once used in a variety of projects at FermiLab. The vendor has it peel strength at 90° published and it is about 6-13 oz/inch, or (0.4 – 0.8 lbs/inch). More samples using 3M9882 were made and they were tested using the same apparatus and procedures so that a simple validity of this simple apparatus could be made. However, this 3M9882 adhesive was expired on February 2005. Two different sets of sample were made due to one of them was kept in a freezer but one was not.

The results were shown below and it could be seen they agreed with what the vendor published basically.

Sample width in inches =		0.9375
Shelf Sample #	Max Force registered in lbs	Peel Strength, lbs/inch
1	1.02	1.09
2	0.86	0.92
3	0.7	0.75
4	0.84	0.90
5	0.62	0.66
Average	0.81	0.86
Freezer Sample #	Max Force registered in lbs	Peel Strength, lbs/inch
1	0.38	0.41
2	0.7	0.75
3	0.28	0.30
4	0.38	0.41
Average	0.44	0.46

The samples after test were shown in Figure 2 in which a peeled area was visible.

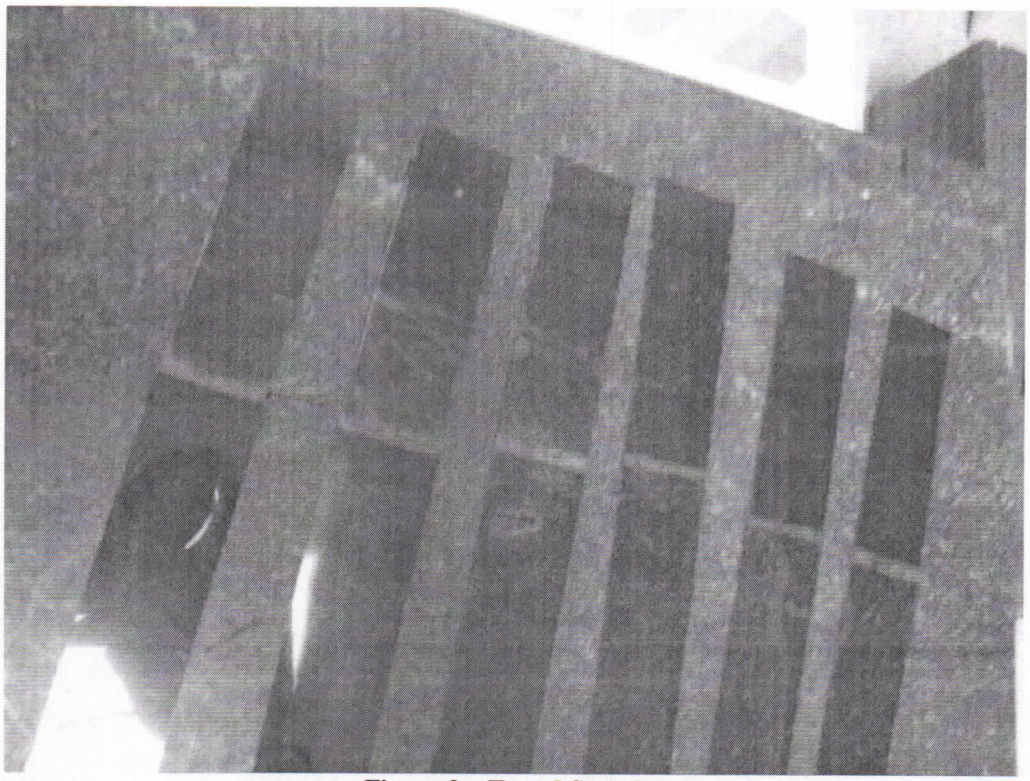

Figure 2 Tested Samples

Conclusion:

Using simple apparatus, a prompt and valid test was done on the ARclad silicone tape although it was not done strictly according to the ASTM standard. An average result over 6 tested samples was obtained and the 90^{o} peel strength of ARclad 8026 tape was about 3.5 lbs per inch.